REMARKS

This paper is being submitted in response to the Office Action mailed July 16, 2003, for the above-referenced application. In this response, Applicants have cancelled claims 17-22 without prejudice or disclaimer of the subject matter thereof and amended claims 1, 3, 5, 6, 16 and 23 to clarify that which Applicants consider to be the invention. Further, Applicants have amended the specification for purposes of clarification. Applicants respectfully submit that the amendments to the claims are fully supported by the originally-filed specification and that the amendments to the specification do not add new subject matter.

The objections to the specification and the claims for containing informalities have been addressed by amendments contained herein according to the guidelines set forth in the Office Action. Accordingly, Applicants respectfully request that the objections be reconsidered and withdrawn.

Submitted herewith is a verified translation of Japanese Patent Application No. 2000-399868 (hereinafter "the Japanese Priority Application"), upon which the above-referenced U.S. patent application claims priority. The Japanese Priority Application was filed on December 28, 2000, and supports pending claims 1-16 and 23-29 of the present U.S. application. (See, for example, pages 4-11 and page 22, lines 15-23 of the verified translation of the Japanese Priority Application.) Accordingly, Applicants respectfully submit that the verified translation of the Japanese Priority Application entitles the above-referenced application to the date of the Japanese Priority Application, December 28, 2000.

The rejection of claims 1-7, 9-16 and 23 under 35 U.S.C. 102(a) as being anticipated by J. App. Phys., 89(11), 2001, 7558-7560 by Fujikata et al. (hereinafter "Fujikata") as evidenced by App. Phys. Let., 79(1), 2001, 57-59 by Portier et al. (hereinafter "Portier") is addressed by submission of the Japanese Priority Application. The date of the Japanese Priority Application, December 28, 2000, is prior to the publication dates of both Fujikata and Portier. Accordingly, Applicants respectfully request that these references be withdrawn and that this rejection also be withdrawn.

The rejection of claims 1, 2, 5, 7-11 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,335,081 to Araki et al. (hereinafter "Araki '081") as evidenced by Portier is hereby traversed and reconsideration is respectfully requested. Insofar as Portier is used in this rejection, Applicants respectfully request that this reference be withdrawn in view of Applicants' entitlement to the priority date of the Japanese Priority Application, as discussed above.

Independent claim 1, as amended herein, recites a spin tunnel magnetoresistive effect film. The film includes at least a structure of lower electrode layer/anti-ferromagnetic thin film/first magnetic thin film/tunnel barrier layer/second magnetic thin film/ and an upper electrode layer, each being successively laminated. An exchange coupling magnetic filed of said first magnetic thin film and said anti-ferromagnetic thin film is Hr. A coercivity of said second magnetic film is Hc2, where Hc2<Hr. Further, an underlayer is disposed between the lower electrode layer and the anti-ferromagnetic thin film and is made of Ta, Zr, Hf, or an alloy thereof, the average surface height unevenness of the anti-ferromagnetic thin film on the underlayer being in the range from 0.1 to 5 Angstroms. Further, an axis of easy magnetization of

the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film. Claims 2, 7-13, 16, 23-29 depend directly or indirectly thereon and recite additional patentable features thereto.

Independent claim 5, as amended herein, recites a spin tunnel magnetoresistive film. The film includes a structure of lower electrode layer/second magnetic thin film/tunnel barrier layer/first magnetic thin film/anti-ferromagnetic thin film/ and an upper electrode layer, each being successively laminated. An exchange coupling magnetic field of the first magnetic thin film and the anti-ferromagnetic thin film is Hr. A coercivity of the second magnetic thin film is Hc2, and wherein Hc2<Hr. An underlayer is disposed between the lower electrode layer and the second magnetic thin film and is made of Ta, Zr, Hf or an alloy thereof. The average surface roughness of the second magnetic thin film is in the range from 0.1 to 5 Angstroms. Further, an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film.

The Araki '081 reference discloses a tunnel magnetoresistance effect element with a tunnel multilayered film. The tunnel multilayered film includes a tunnel barrier layer, a ferromagnetic free layer and a ferromagnetic pinned layer. Three indexes are utilized to represent surface roughness state of a surface that affect characteristics of the tunnel

magnetoresistance effect element. (See Abstract and col. 2, lines 27-49 of Araki '081).

Applicants' independent claims, as amended herein, all recite the feature that *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film.* When the magnetization orientations of neighboring magnetic thin films are mutually opposite, By controlling the axes of magnetization of the magnetic thin films in this manner, Applicants' have found that Barkhausen noise can be suppressed. (See page 13, lines 6-26 of the present application). Further, by bringing a permanent magnet film into contact with the easy magnetization of the second magnetic film, that is non-adjacent to the anti-ferromagnetic film, it is possible to achieve magnetic domain stability and avoid non-linear output, such as due to Barkhausen jumping. (See page 16, lines 3-11 of the present application).

Applicants respectfully submit that Araki '081 does not teach or fairly suggest at least the above feature as claimed by Applicant. Araki '081 discloses ferromagnetic layers 20 and 40 that are parallel in magnetization to each other and that are anti-parallel in magnetization to each other. (See col. 9, lines 24-34 of Araki '081). However, Araki '081 does not teach or suggest a spin tunnel magnetoresistance effect film in which *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of*

easy magnetization of the second magnetic thin film, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 3, 4, 6 and 14-16 under 35 U.S.C. 103(a) as being unpatentable over Araki '081 in view of U.S. Patent No. 6,127,045 to Gill (hereinafter "Gill") and IEEE. Trans Mag., 35(5), 1999, 2919-2921 by Park et al. (hereinafter "Park") is hereby traversed and reconsideration is respectfully requested.

Independent claim 3, as amended herein, recites a spin tunnel magnetoresistive film. The film includes a structure of lower electrode layer/anti-ferromagnetic thin film/third magnetic thin film/non-magnetic thin film/fourth magnetic thin film/first magnetic thin film/tunnel barrier layer/second magnetic thin film/ and an upper electrode layer, each being successively laminated. The third magnetic thin film and the fourth magnetic thin film are anti-ferromagnetically coupled via said non-magnetic thin film, and wherein an exchange coupling magnetic filed of the first magnetic thin film and said anti-ferromagnetic thin film is Hr, a coercivity of the second magnetic thin film is Hc2, wherein Hc2<Hr. An underlayer is disposed between the lower electrode layer and the anti-ferromagnetic thin film and made of Ta, Zr, Hf, or an alloy thereof. The average surface roughness of the anti-ferromagnetic thin film being in the range from 0.1 to 5 Angstroms. Further, an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film. Claims 4, 14, and 15 depend on independent

claim 3 and recites additional patentable features thereto.

Independent claim 6, as amended herein, recites a spin tunnel magnetoresistive effect film. The film includes a structure of lower electrode layer/second magnetic thin film/tunnel barrier layer/first magnetic thin film/fourth magnetic thin film/non-magnetic thin film/third magnetic thin film/anti-ferrogmagnetic thin film/ and an upper electrode layer, each being successively laminated. The third magnetic thin film and the fourth magnetic thin film are anti-ferromagnetically coupled via said non-magnetic thin film. An exchange coupling magnetic field of the first magnetic thin film and the ant-ferromagnetic thin film is Hr. A coercivity of the second magnetic thin film is Hc2, and wherein Hc2<Hr. An underlayer is disposed between the lower electrode layer and the second magnetic thin film and made of Ta, Zr, Hf, or any alloy thereof. The average surface roughness of the second magnetic thin film is in the range from 0.1 to 5 Angstroms. Further, an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film.

The Araki '081 reference is discussed above.

The Park reference is cited by the Office Action as disclosing the use of interface layers between free and pinned layers in order to improve the magnetoresistance ratio.

The Gill reference is cited by the Office Action as disclosing that interface layers can also be used adjacent to synthetic antiferromagnetically coupled layers.

Applicants respectfully submit that neither the Gill reference nor the Park reference overcome the above noted deficiencies of the Araki '081 reference with respect to Applicants claims. Specifically, neither Araki '081, Gill nor Park, taken alone or in any combination, teach or fairly suggest a spin tunnel magnetoresistance effect film in which *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film*, as is claimed by Applicants. Park discloses a magnetic field applied to induce parallel easy magnetization axes in each electrode. (See page 1, section II of Park). Gill discloses ferromagnetic layers separated by a tunnel barrier layer and magnetized in a generally perpendicular orientation; however, the pinned ferromagnetic layer of Gill 220 is ***adjacent to*** the anti-ferromagnetic (AFM) layer 230 of Gill. (See Abstract, Fig. 2 of Gill). The prior art of record does not teach or fairly suggest at least the above features as claimed by Applicants.

Accordingly, in view of the above, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 2 and 4 under 35 U.S.C. 103(a) as being unpatentable over Araki '081 in view of U.S. Patent No. 6,484,675 to Araki et al. (hereinafter "Araki '675") is hereby

traversed and reconsideration is respectfully requested.

Dependent claims 2 and 4 depend from independent claims 1 and 3, respectively, which are discussed above.

The Araki '675 reference is cited by the Office Action as disclosing a surface roughness of a magnetic thin film and tunnel barrier to be less than 5 Angstroms.

Applicants' respectfully submit that Araki '675 does not overcome the above-noted deficiencies of the Araki '081 reference with respect to Applicants' claims. Specifically, neither Araki '081 nor Araki '675, taken alone or in combination, teach or fairly suggest a spin tunnel magnetoresistance effect film in which *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 12 and 13 under 35 U.S.C. 103(a) as being unpatentable over Araki '081 in view of JP 10-162320 to Suzuki (hereinafter "Suzuki") and U.S. Patent No. 5,849,422 to Hayashi (hereinafter "Hayashi") is hereby traversed and reconsideration is respectfully requested.

Dependent claims 12 and 13 depend from independent claim 1, discussed above.

The Suzuki reference is cited by the Office Action as disclosing that amorphous CoZr alloy magnetic materials are equivalent magnetic materials for the soft magnetic layer provided between the antiferromagnetic layer and the substrate.

The Hayashi reference is cited by the Office Action as disclosing that an amorphous CoZr alloy is a preferred choice in a spin valve system because of its good magnetic characteristics.

Applicants' respectfully submit that Suzuki and Hayashi do not overcome the above-noted deficiencies of the Araki '081 reference with respect to Applicants' claims. Specifically, neither Araki '081, Suzuki nor Hayashi, taken alone or in combination, teach or fairly suggest a spin tunnel magnetoresistance effect film in which *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 23 and 26 under 35 U.S.C. 103(a) as being unpatentable over Araki '081 in view of U.S. Patent No. 6,519,124 to Redon et al. (hereinafter "Redon") and U.S. Patent App. No. 2002/0097534 to Sun et al. (hereinafter "Sun") is hereby traversed and

reconsideration is respectfully requested.

Dependent claims 23 and 26 depend directly or indirectly on independent claim 1, which is discussed above.

The Redon reference is cited by the Office Action as disclosing resistance values of a magneto-resistive tunnel junction.

The Sun reference is cited by the Office Action as disclosing resistance ranges obtainable for various tunnel barrier layer thickness values.

Applicants' respectfully submit that Redon and Sun do not overcome the above-noted deficiencies of the Araki '081 reference with respect to Applicants' claims. Specifically, neither Araki '081, Radon nor Sun, taken alone or in combination, teach or fairly suggest a spin tunnel magnetoresistance effect film in which *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 24 and 25 under 35 U.S.C. 103(a) as being unpatentable over Araki '081 in view of Redon and Sun and further in view of Suzuki is hereby traversed and

reconsideration is respectfully requested.

Dependent claims 24 and 25 depend on independent claim 1, which is discussed above.

The Araki '081, Redon, Sun and Susuki references are discussed above.

Applicants' respectfully submit that Redon, Sun, and Suzuki do not overcome the above-noted deficiencies of the Araki '081 reference with respect to Applicants' claims. Specifically, neither Araki '081, Radon, Sun nor Suzuki, taken alone or in combination, teach or fairly suggest a spin tunnel magnetoresistance effect film in which *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claim 27 under 35 U.S.C. 103(a) as being unpatentable over Araki '081 in view of Redon and Sun and further in view of IEEE Trans. Mag., 35(5), 1999, 2586-2588 to Coehoorn et al. (hereinafter "Coehoorn") is hereby traversed and reconsideration is respectfully requested.

Dependent claim 27 depends indirectly on independent claim 1, which is discussed above.

The Coehoorn reference is cited by the Office Action as disclosing that yoke-type magnetic sensors comprising TMR elements and soft-magnetic films are known in the art to possess intrinsically lower nose than shield-type magnetic heads.

Applicants' respectfully submit that Redon, Sun, and Coehoorn do not overcome the above-noted deficiencies of the Araki '081 reference with respect to Applicants' claims. Specifically, neither Araki '081, Radon, Sun nor Coehoorn, taken alone or in combination, teach or fairly suggest a spin tunnel magnetoresistance effect film in which *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 28 and 29 under 35 U.S.C. 103(a) as being unpatentable over Araki '081 in view of Redon and Sun and further in view of Gill is hereby traversed and reconsideration is respectfully requested.

Dependent claims 28 and 29 depend indirectly on independent claim 1, which is discussed above.

The Araki '081, Redon, Sun and Gill references are also discussed above.

Applicants' respectfully submit that Redon, Sun, and Gill do not overcome the above-noted deficiencies of the Araki '081 reference with respect to Applicants' claims. Specifically, neither Araki '081, Radon, Sun nor Gill, taken alone or in combination, teach or fairly suggest a spin tunnel magnetoresistance effect film in which *an axis of easy magnetization of the first magnetic thin film is substantially perpendicular to an axis of easy magnetization of the second magnetic thin film, and the second magnetic film, being non-adjacent to said anti-ferromagnetic layer, contacts a permanent magnet film magnetically oriented in the direction of said axis of easy magnetization of the second magnetic thin film*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claim 8 under 35 U.S.C. 103(a) as being unpatentable over Fujikata in view of Araki '675 is addressed by submission of the Japanese Priority Document. As discussed above, the date of the Japanese Priority Application, December 28, 2000, is prior to the June 1, 2001, publication date of the Fujikata reference. Accordingly, Applicants respectfully request that this rejection be withdrawn.

The rejection of claims 24 and 25 under 35 U.S.C. 103(a) as being unpatentable over Fujikata in view of Suzuki is addressed by submission of the Japanese Priority Document. As discussed above, the date of the Japanese Priority Application, December 28, 2000, is prior to the June 1, 2001, publication date of the Fujikata reference. Accordingly, Applicants respectfully request that this rejection be withdrawn.

The rejection of claim 26 under 35 U.S.C. 103(a) as being unpatentable over Fujikata in view of Araki '081 is addressed by submission of the Japanese Priority Document. As discussed above, the date of the Japanese Priority Application, December 28, 2000, is prior to the June 1, 2001, publication date of the Fujikata reference. Accordingly, Applicants respectfully request that this rejection be withdrawn.

The rejection of claim 27 under 35 U.S.C. 103(a) as being unpatentable over Fujikata in view of Coehoorn is addressed by submission of the Japanese Priority Document. As discussed above, the date of the Japanese Priority Application, December 28, 2000, is prior to the June 1, 2001, publication date of the Fujikata reference. Accordingly, Applicants respectfully request that this rejection be withdrawn.

The rejection of claim 28 under 35 U.S.C. 103(a) as being unpatentable over Fujikata in view of Gill is addressed by submission of the Japanese Priority Document. As discussed above, the date of the Japanese Priority Application, December 28, 2000, is prior to the June 1, 2001, publication date of the Fujikata reference. Accordingly, Applicants respectfully request that this rejection be withdrawn.

The rejection of claim 29 under 35 U.S.C. 103(a) as being unpatentable over Fujikata in view of Araki '081 and further in view of Gill is addressed by submission of the Japanese Priority Document. As discussed above, the date of the Japanese Priority Application, December 28, 2000, is prior to the June 1, 2001, publication date of the Fujikata reference. Accordingly,

Applicants respectfully request that this rejection be withdrawn.

Based on the above, Applicants respectfully request that the Examiner reconsider and withdraw all outstanding rejections and objections. Favorable consideration and allowance are earnestly solicited. Should there be any questions after reviewing this paper, the Examiner is invited to contact the undersigned at 617-248-4038.

Respectfully submitted,
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CERTIFICATE OF VERIFICATION

I, Yasuyuki Hata of c/o Saito & Hata International Patent Office, Akasaka-taisei Bldg., 1-18, Akasaka 1-chome, Minato-ku, Tokyo, Japan, hereby certify that I am the translator of the document attached and I state that the attached document is a true and complete translation to the best of my knowledge and belief of Japanese Patent Application No. 2000-399868 filed on December 28, 2000.

Dated this 15th day of October 15, 2003

Signature of translator

Yasuyuki Hata